# TOPIC 2

# TIME-CONVERSION COMPUTATION

With U.S. naval ships and aircraft deployed throughout the world, time computation becomes a matter of concern to virtually every naval member. Communicators use ZULU time in messages and other record communications. It is extremely important that you know how to make time conversions from local to ZULU time and from ZULU to local time. Those involved in collection, processing and reporting, and traffic analysis must be able to make quick and accurate time conversions throughout their working day.

## CONVERSION FROM LOCAL TIME TO ZULU TIME

We know the ZULU time zone has the numerical designator zero (0). At this point, the "+" or "-" assigned to each of the other zones comes into play. To convert the local time to ZULU time, simply add or subtract as indicated by the sign (+ or -) of the local time zone.

For example, we are in Pensacola, Florida, and wish to assign a date-time group (DTG) to a message. We will have to use ZULU time for the message. Pensacola is in the SIERRA time zone and is designated +6. The local date and time is 191045S (the 19th of the month at 10:45 A.M.). Since the SIERRA time zone is +6 (Pensacola local time), add 6 to the local time of 1045. Our answer is the conversion of 191045S to ZULU time 191645Z.

Our problem looks like this:

| | |
|---|---|
| 191045S | (local DTG) |
| +6 | (Pensacola is in zone +6) |
| 191645Z | (ZULU DTG) |

NOTE: Remember, the +6 must be placed under the "hours" of the local DTG.

RULE: FROM LOCAL TIME TO ZULU TIME—APPLY THE SIGN.

To check ourselves for complete understanding, let's take one more example of converting local time to ZULU time. This time we are in Kamiseya, Japan, and wish to assign a DTG to an outgoing message. First, we have to know the zone designation for Kamiseya—INDIA (-9). The date and time in Kamiseya is 101800I. Using our formula, we apply the "-" sign and subtract the local zone (9) from the local time:

| | |
|---|---|
| 101800I | (local DTG) |
| - 9 | (Kamiseya is in zone -9) |
| 100900Z | (ZULU DTG) |

These examples can help you convert local time to ZULU time from any place in the world. The only variations that you will encounter involve the International Date Line and daylight saving time (DST), each of which will be treated separately later.

## CONVERSION FROM ZULU TIME TO LOCAL TIME

The conversion from ZULU time to local time is the reverse procedure of local to ZULU. For example, you are in San Diego, California, and receive a message from Washington, D.C., with a DTG of 101800Z. If you want the Washington local time of message origination, you need to know the zone designations for Washington—ROMEO +5. Then, apply the formula. Change the sign from +5 to -5 and subtract the 5 hours from the ZULU time of the message:

101800Z (ZULU DTG)
 - 5 (Washington zone with "+" reversed)
―――――
101300R (local DTG)

RULE: FROM ZULU TO LOCAL—REVERSE THE SIGN.

To check ourselves, let's work another example of converting ZULU to local. The U.S. Ambassador to Japan has received a message from the U.S. Secretary of State concerning the latter's plans to visit Tokyo. The Secretary has indicated an arrival time of 210830Z. The Ambassador's problem is one of diplomacy: Should he arrange a luncheon or an evening meal for the arrival of the distinguished guest? We need not concern ourselves with the geographic location of the Secretary of State because he used ZULU time. However, we must know the location and designators for Tokyo—INDIA (-9). Armed with this knowledge, apply the formula. We reverse the local sign (change the -9 to a +9), and work the math:

210830Z (ZULU arrival time)
 + 9 (local zone with "-" reversed)
―――――
211730I (local arrival time)

Forget the soup and sandwiches, he'll be there for supper!

NOTE: You may see some commercially produced time zone charts with the numerical zone designators reversed ("+" for the eastern hemisphere and "-" for the western hemisphere). Don't let this confuse you. Remember, in the eastern hemisphere the time will always be later than ZULU and in the western hemisphere it will always be earlier than ZULU.

## COMPUTING TIME IN GEOGRAPHIC POSITIONS

*Coordinates* is a general term for numbers representing the degrees, minutes, and seconds of a geographic position. The correlation of time and geographic coordinates is a critical skill for members of the intelligence community. Once you have learned to convert time from local to ZULU and from ZULU to local, the conversion using positional coordinates is a simple matter.

Let's consider a typical position report. A position report is normally sent as two sets of numbers. The first set of numbers is the latitude (north or south). The second set of numbers is the longitude (east or west) and is the set that we use in time conversion. Normally, the longitude of a position report (the second set of numbers) is sent as a five-digit group. The first three digits of this group indicate the geographical degrees; the last two are the minutes. The group is followed immediately by an "E" (east) or a "W" (west) to indicate the hemisphere. For example, 115°30´W indicates the location is 115 degrees and 30 minutes west of the prime meridian.

There are 180° of longitude to the west of Greenwich and 180° longitude to the east (180°W longitude and 180°E longitude = International Date Line—the 180th meridian). Each degree can be broken into 60 minutes.

As stated above, the five-digit longitude is normal; however, sometimes you will encounter a seven-digit longitude. This is simply a further breakdown of the minutes into seconds. One minute contains 60 seconds. When this occurs, the first three digits indicate degrees; the next two digits indicate minutes; and the last two digits indicate seconds. In any event, the longitude of a position will place the target into a specific time zone.

To determine this zone, we'll use a hypothetical position report sent in chatter: 12°35´N 072°42´W. We may disregard the first set of numbers (latitude) and concern ourselves only with the second set of numbers (longitude). The "072°" represents the number of degrees of longitude from the prime meridian (Greenwich) and the "42´" is the number of geographical minutes from the 072 degree line (72nd meridian). The "W" tells us that the target is located to the west of the prime meridian, in the western hemisphere.

NOTE: Remember, a time zone spans 15° of longitude, with the ZULU zone divided into 7½° of longitude east and 7½° of longitude west of the prime meridian.

The first step in our computation is to draw a graphic chart showing the western half of the ZULU time zone. Now, label the western border of the ZULU time zone (7½° west longitude, or 007°30´W). We must now continue our chart, proceeding outward from ZULU, labeling the western borders of each of the time zones until we reach a point where the hypothetical longitude is equaled or exceeded.

For example, the western border of zone

NOVEMBER is 022°30´W (007°30´ + 15°);

OSCAR is 037°30´W;

PAPA is 052°30´W;

QUEBEC is 067°30´W; and

ROMEO is 082°30´W.

Once we reach the fast meridian to exceed the longitude (in this case, ROMEO zone's western border is the first of the western borders to exceed our longitude of 072°42´W), we need go no further with our labeling. See figure 1-1. Longitude 072°42´W falls to the west of zone QUEBEC, but not past zone ROMEO. Our longitude falls within the ROMEO zone, or zone +5.

After determining the time-zone designation for our target, we apply or reverse the sign, depending upon whether we want to determine the ZULU time from local time, or the local time from ZULU time. Longitudes in the eastern hemisphere are handled in the same way, except that the eastern borders are used instead of the western borders.

Let's look at another example. This time we will establish the target's time-zone designators (its longitudinal parameters). An unlocated ship sends its local time as 0945. Your local time is 1345B. The first step in solving this problem is to convert your local time to ZULU. Use the formula, FROM LOCAL TO ZULU—APPLY THE SIGN. All you have to do is subtract your time zone from your local time to arrive at ZULU. Zone BRAVO is -2. By subtracting the local time zone of -2 from your local time of 1345B, you arrive at ZULU time—1145Z. Since it has been established that it is 1145Z, and the target operator has given his local time as 0945, all you need to do is subtract the smaller figure from the larger. The difference will equate to the time zone of the target.

```
 1145
-0945
 ----
 0200    (or +2 time zone)
```

After all, if it is 1145Z in BRAVO zone, it must also be 1145Z in OSCAR and in all other zones.

## COMPUTATIONS INVOLVING THE INTERNATIONAL DATE LINE

In our discussions of the International Date Line, we covered two very important points which bear repeating:

1. It is always the same time in zone MIKE as it is in zone YANKEE—it is *never* the same day.
2. When you cross the International Date Line, apply the sign of the *departed* hemisphere to determine whether to add or to subtract a day. Keep in mind that whenever we cross the line, the day *must* change.

To illustrate the effect that the International Date Line has upon a DTG, let's assume that we are flying from Tokyo to San Francisco. We begin by listing the facts that we must know about each place:

1. The time zone designators of Tokyo—INDIA (-9).
2. The time zone designators of San Francisco—UNIFORM (+8).
3. The date and time of departure from Tokyo—20 April, at 0800I.
4. The flying time is 13 hours.

THE PROBLEM: What will be the local time and date when we land in San Francisco?

To solve this problem, make a graphic chart showing each of the time zones between Tokyo and San Francisco, labeling each zone with its designators. See figure 1-1. (Don't forget to label the International Date Line.) Using our roughly drawn chart, let's fill in the times between Tokyo (-9) and the Date Line. Since we are moving in an easterly direction we add 1 hour upon entering each new time zone.

We have now reached the International Date Line and find that, before crossing the line, the local time is 201100M. We cross the line, departing - 12 and entering + 12. Using our formula for crossing the International Date Line, we apply the sign of the departed hemisphere and subtract 1 day—it is now the 19th of April. As stated before, the hour will remain the same in YANKEE (1100Y) as it was when we departed MIKE—only the day changes.

Now let's leave YANKEE and continue adding 1 hour for each new zone. Remember, it is now the 19th, NOT the 20th, as it was when we left Japan.

As we arrive in San Francisco's time zone (UNIFORM), the local time is 191500U. However, this is NOT the answer we are seeking. All we have determined thus far is that when it is the 20th of April at 0800 local time in Tokyo, it is the 19th of April at 1500 local time in San Francisco. We are not finished with the problem until we have added the flying time to the local time in San Francisco. By adding the 13 hours flying time, we find that our arrival time in San Francisco should be 200400U.

## COMPUTATIONS INVOLVING DAYLIGHT SAVING TIME (DST)

In computing time conversions, you will frequently encounter problems where one or both of the zones are using DST. Since the purpose of this time modification is to extend the daylight hours (primarily in the summer months), all we have to do is to understand what is done to establish this time.

DST is simply the setting of the clocks in a particular area ahead 1 hour, thus extending the onset of darkness by that margin. Whenever we encounter a problem involving DST, we work the problem according to the methods outlined above, then subtract 1 hour. This will give us the normal time for that zone. If we are asked to solve a time-conversion problem for a time zone using normal time and instructed to give the answer in DST, we work the problem and add 1 hour to obtain the time in DST.

## TIME-CONVERSION WORKING AIDS

Most of us have seen charts or maps of the world showing time zones. These are handy tools to have when computing time. Obviously, we can't be expected to carry charts or maps around in our back pocket everywhere we go. The Navy has a 4" × 6" working aid, the time-conversion table. It is small enough to carry in your wallet and is readily available at most field stations. Also, there are many commercially produced materials. Some of these are better than others.

### TIME-CONVERSION TABLE

The time-conversion table has 24 horizontal rows depicting the 24 hours of the day, and 25 vertical columns showing the 25 time zone designators. See table 2-1. Notice that zones MIKE and YANKEE are identical, with the exception of the day.

To use the time-conversion table, find the zones in question along the horizontal row at the bottom of the table and go up the vertical column of the known time zone. Then find the corresponding vertical position of the unknown zone. You now have the time of the unknown zone in relation to the known zone. It's as simple as that.

### COMMERCIAL TIME-CONVERSION AIDS

The commercially produced time-conversion aids, primarily designed to aid the tourist, are inadequate for military and communications use. They generally disregard zone designators and the computation processes. Figure 2-1 shows a typical tourist-oriented, time-conversion aid and is included in this manual only as an example of these aids.

We have discussed time-conversion working aids only to advise you that there are shortcuts. There are no shortcuts to professionalism, however, and each of the time-conversion aids has its shortcomings. Did you notice that the time-conversion table is of no help in establishing positional locations of targets? Additionally, if you are on a direct-support platform, or at an isolated duty station where the time conversion table is not available, the success of your mission might well depend upon your ability to compute time.

## TOPIC SUMMARY

If any one of these areas is unclear to you, go back to the discussion and master that procedure.

1. To determine ZULU time from local time, apply the sign ("+" or "-") and add or subtract the numerical designator to or from the local time's hours.
2. To determine local time from ZULU time, reverse the sign ("+" or "-") and add or subtract the new numerical designator to or from the ZULU time's hours.
3. In problems involving geographical positions:

    a. Latitude is irrelevant for figuring time; use only the longitude.

    b. Use all five digits of the longitude (seven digits, if given).

    c. Proceed in an easterly or westerly direction from the prime meridian, according to the "E" or "W" designation.

    d. Make a rough, graphic chart to establish the zone in which a given longitude falls.

    (1) Enter the longitudinal coordinates for the ZULU zone (007°30´E or 007°30´W).

Table 2-1.—Time-Conversion Table

| Y +12 | X +11 | W +10 | V +9 | U +8 | T +7 | S +6 | R +5 | Q +4 | P +3 | O +2 | N +1 | Z 0 | A −1 | B −2 | C −3 | D −4 | E −5 | F −6 | G −7 | H −8 | I −9 | K −10 | L −11 | M −12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PREVIOUS DAY | | | | | | | SAME DAY | | | | | | | | | | | | | | | | | |
| 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 |
| 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 |
| 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 |
| 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 |
| 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 |
| 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 |
| 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 |
| 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 |
| 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 |
| 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 |
| 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 |
| 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 |
| 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 |
| 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 |
| 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 |
| 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 |
| 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 |
| 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 |
| 1200 | 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 |
| 1300 | 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 |
| 1400 | 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 |
| 1500 | 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 |
| 1600 | 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 |
| 1700 | 1800 | 1900 | 2000 | 2100 | 2200 | 2300 | 2400 | 0100 | 0200 | 0300 | 0400 | 0500 | 0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700 |
| SAME DAY | | | | | | | | NEXT DAY | | | | | | | | | | | | | | | | |

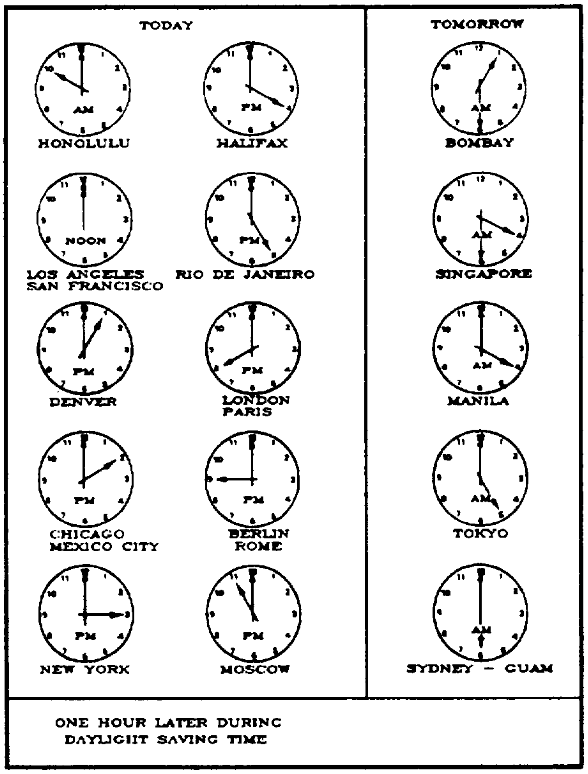


**Figure 2-1.—Typical commercial time-conversion aid.**

(2) When traveling from the eastern or western border of zone ZULU, add 15° for each new zone; place this new longitudinal coordinate at the eastern or western meridian of the zone, as required.

e. Solve the time problem like any other problem after placing the target into the zone corresponding to its longitudinal coordinates.

4. In problems involving the use of a target's local time to establish its longitudinal parameters:

a. Convert your local time to ZULU.

b. Work from ZULU time to derive the local time of the target.

c. Place the target within its geographic zone once the local time is determined.

5. In problems involving the International Date Line:

a. Separate the MIKE and YANKEE zones.

b. Label both "+" and "-" designators (MIKE is "-"; YANKEE is "+").

c. It is always the same time in MIKE as it is in YANKEE, but *never* the same day.

d. The day must change each time the International Date Line is crossed.

e. Apply the sign of the *departed* hemisphere when crossing the line to determine whether to add or to subtract a day.

6. In problems involving daylight saving time (DST):

a. When time is given in DST, work the problem in normal fashion, then subtract 1 hour to arrive at the zone's normal time.

b. When the zone's normal time is given, work the problem in the usual fashion, then add 1 hour to determine DST.

## REFERENCES

*Communications Instructions General,* ACP 121(F), Annex A, Joint Chiefs of Staff, Washington, DC, 15 April 1983.